Matthew Gordon

mgmake.com | github.com/mjgordon

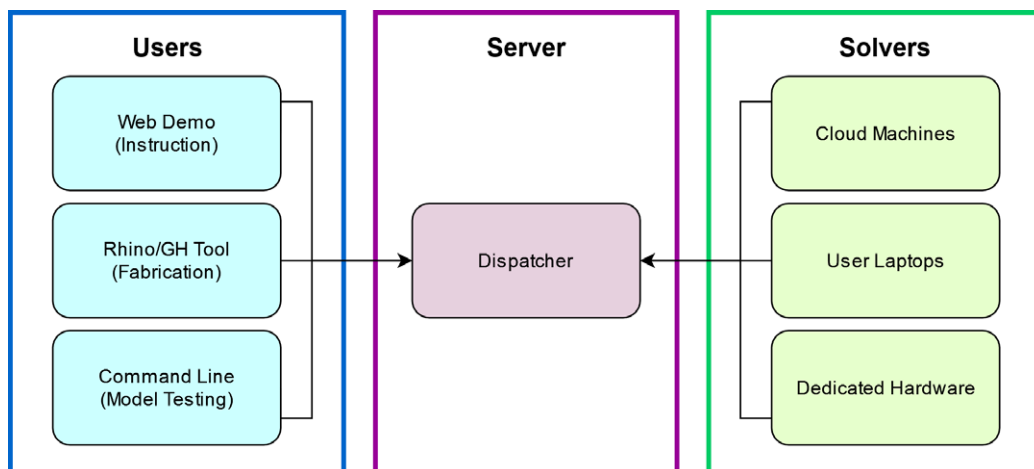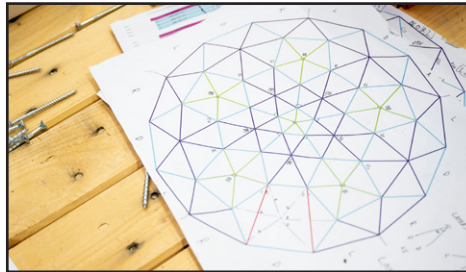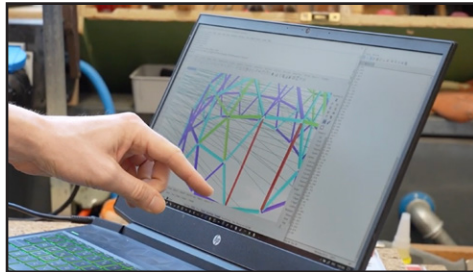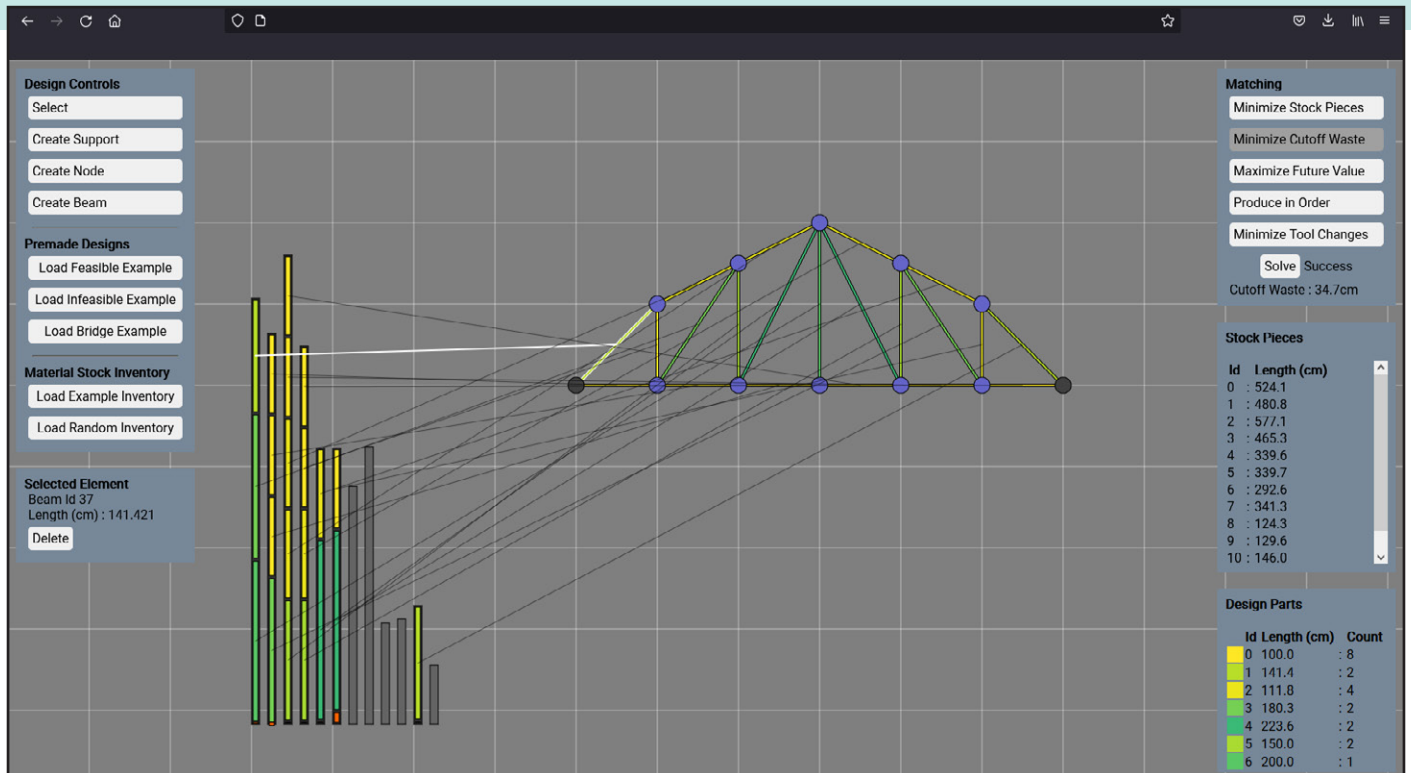Circularity | Fabrication | Design | Art

Design Reuse Material Matching & Optimization

Chair of Circular Engineering for Architecture, ETH Zurich


Frontend and backend system for optimization in matching reused materials with new designs. Implemented applications include a webapp to introduce reuse optimization concepts in teaching, a Rhino/GH interface used to produce a pavilion-scale prototype, and analysis of alternative optimization goals. The system supports transparent simultaneous use of multiple solver machines by multiple users.

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Automating Building Element Detection

Chair of Circular Engineering for Architecture, ETH Zurich
Published in Automation in Construction, 2023, Gordon et. al.
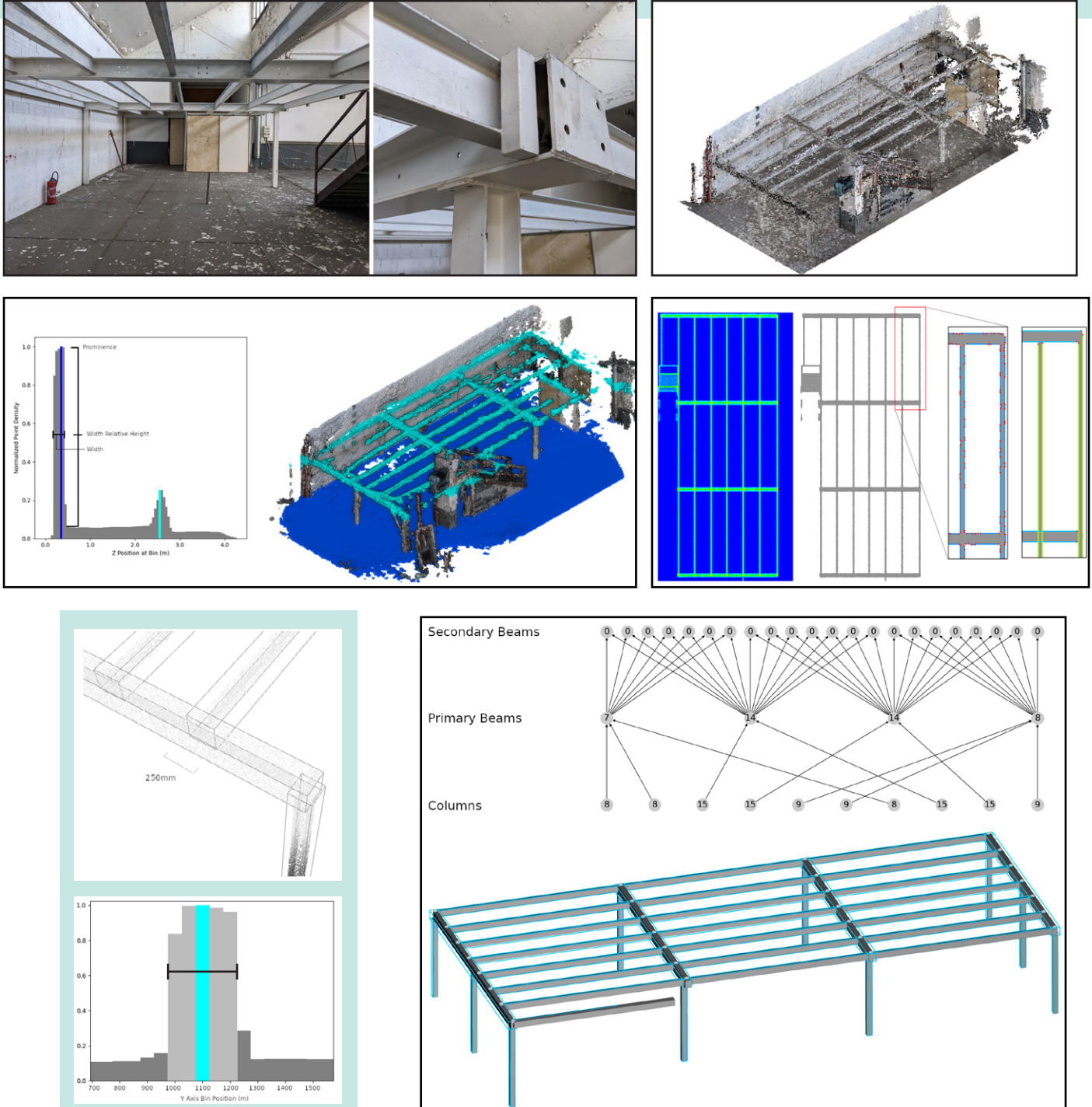
A specific Scan-to-BIM methodology and tool developed for steel beam and column systems, for use in material recovery planning. We focused on the usage of low-cost and noisy data sources, and the application of existing techniques for lesser-studied structural components.

The tool also used a graph-based analysis of the reconstructed BIM to estimate the recoverability complexity of the detected building components, based on their relative connections.
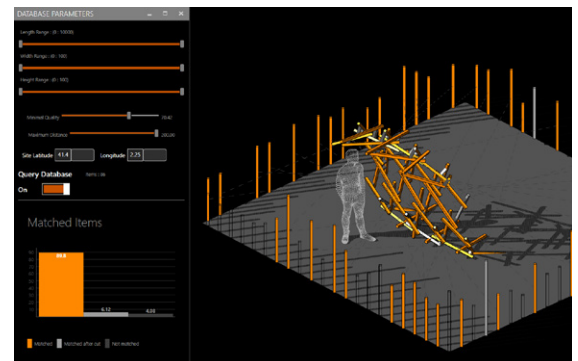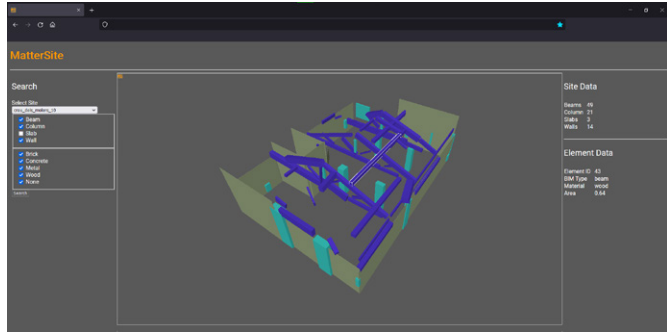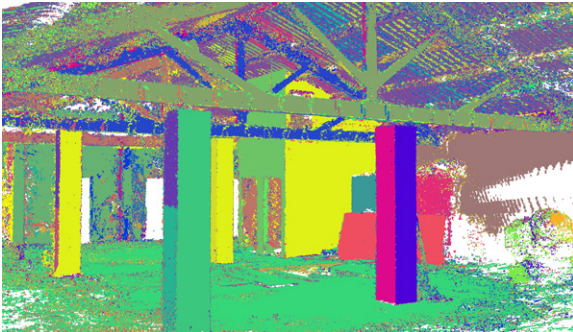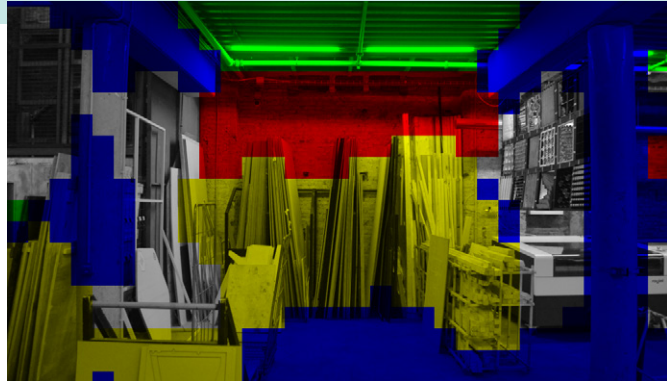
Matthew Gordon

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Circularity | Fabrication | Design | Art

Mattersite

IaaC, Barcelona | Masters Thesis
In Collaboration with Roberto Vargas

A multiphase investigation into practical reuse of post-demolition materials in the building industry. Its principal parts include photogrammetry-focused scan-to-BIM, computer-vision material localisation, recovered component scanning and defect detection, and assistive tools for fabrication with unique components, with web and design software interfaces for accessing and using this information.
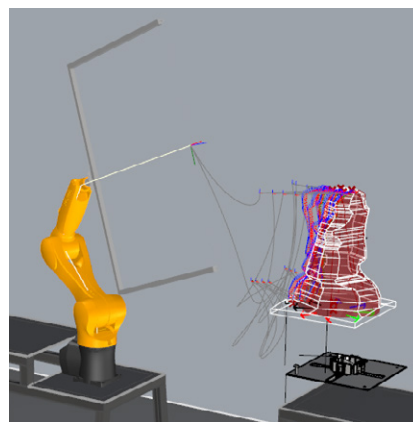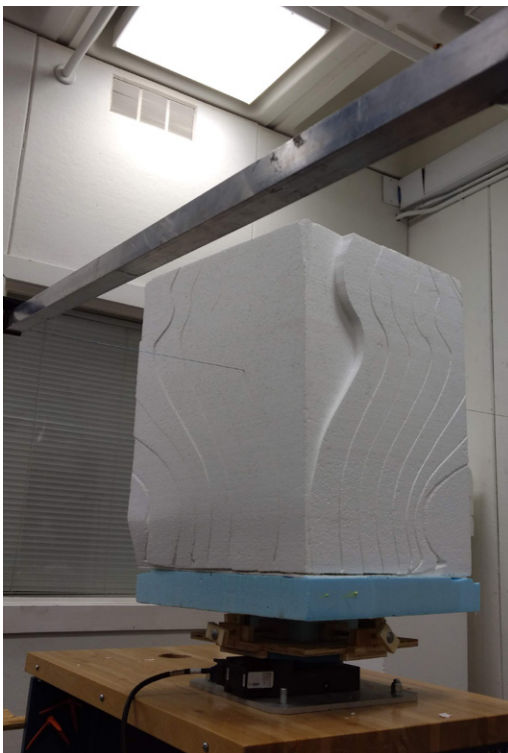
Digital Fabrication Sculpture Workshop

Architectural Robotics Research Group, University of Virginia

DESIGN BY JULIA TREUBERT

'CONSENT' BY JAMES NEMER

I was a primary collaborator for an interdisciplinary workshop teaching fine-art sculpture students 3d modeling and hot-wire foam fabrication. Led by visiting artist Michael Rees, I designed the workflow to translate original CAD meshes into ruled surface tool-paths, and ran the hands-on component, teaching the tool and basic robot skills. I also assisted one of these students in the fabrication of a large scale, multi-component piece based on a digitally-scanned maquette, employing these techniques.

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Computer-Vision Bricklaying

Architectural Robotics Research Group, University of Virginia
In Collaboration with Ben Lawon
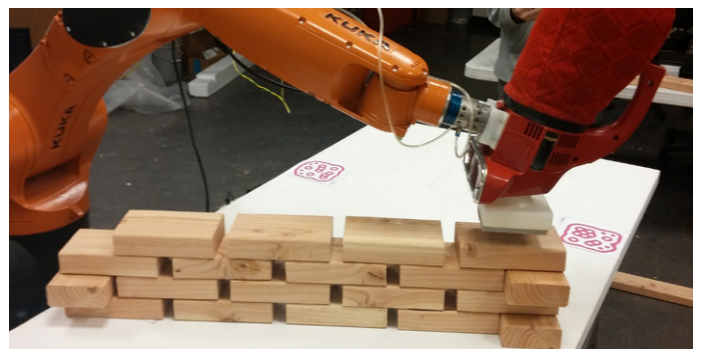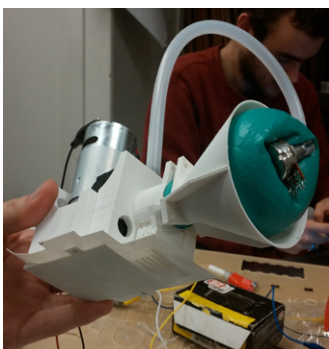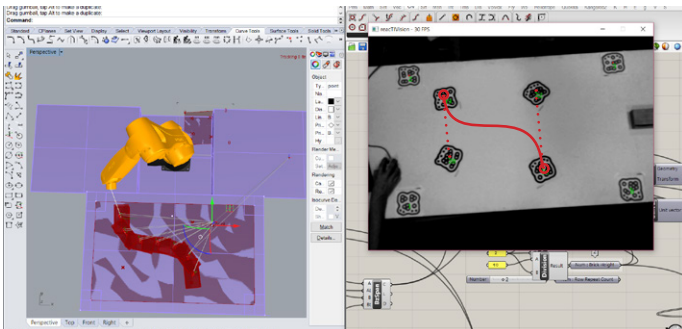
Investigation towards developing a reactive and physically controllable pick-and-place workflow. Block wall designs are generated based on physical reacTIVision tags, and generate pick-and-place robotic toolpaths. The basic curve is defined by the computer vision system, then recursive collision detection and shifting is applied to create the final interlocking layout.

The wall is assembled using a network-controlled vacuum gripper system. Implemented toolheads include a 'universal gripper' employing particulate jamming, and a modified consumer vacuum for flat surfaces.

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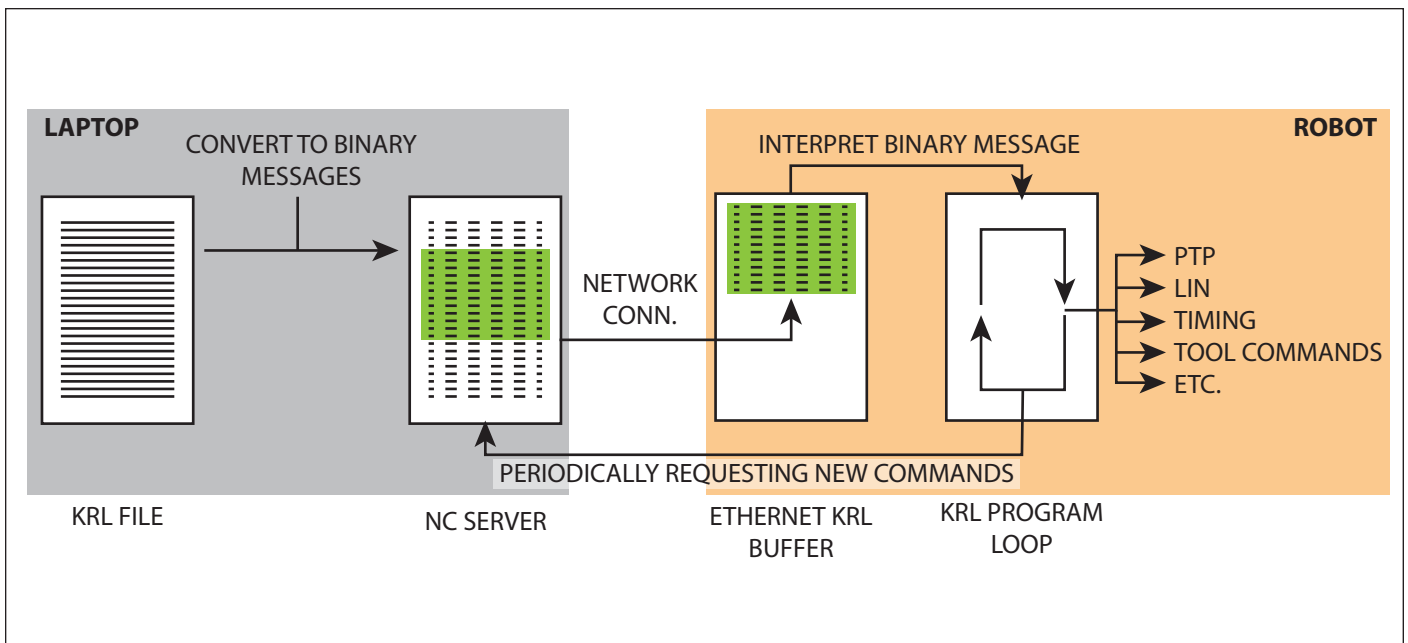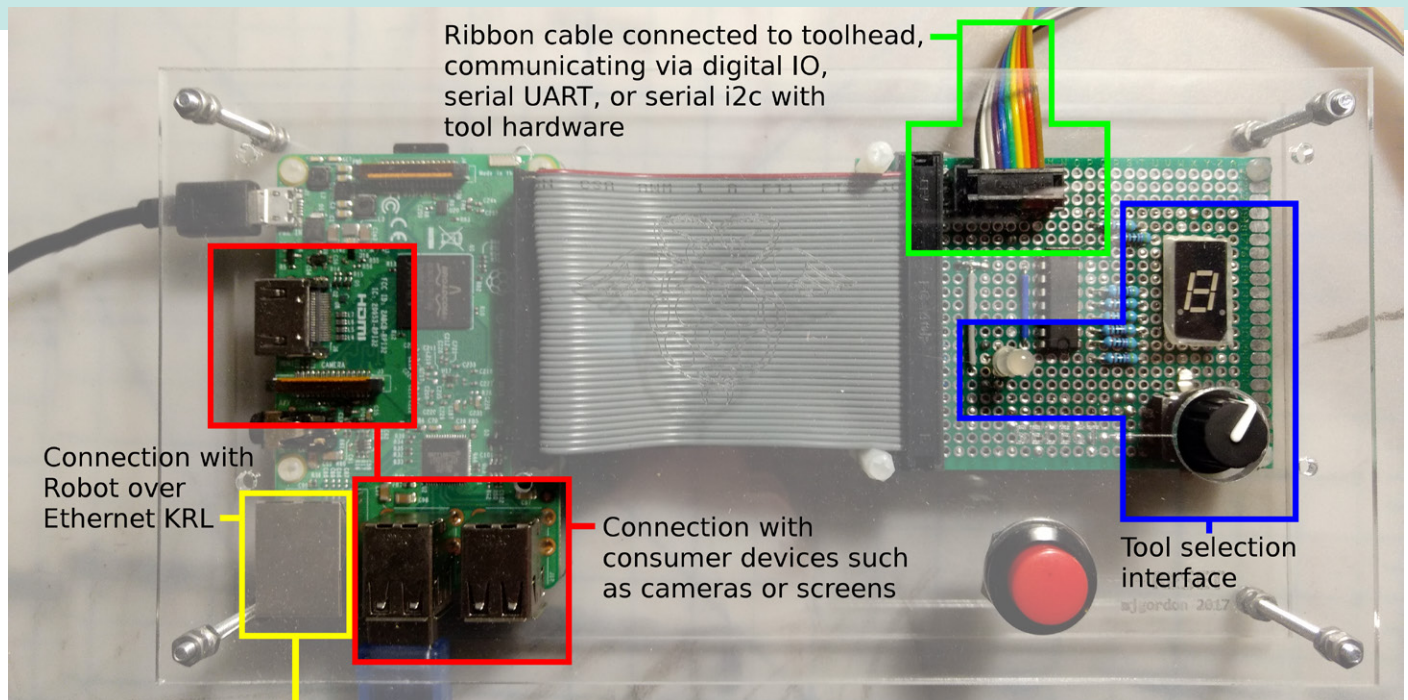
Discrete Robotic Bending

IaaC, Barcelona
In Collaboration with Abdullah Sheikh, Andreea Bunica, Anna Battalé
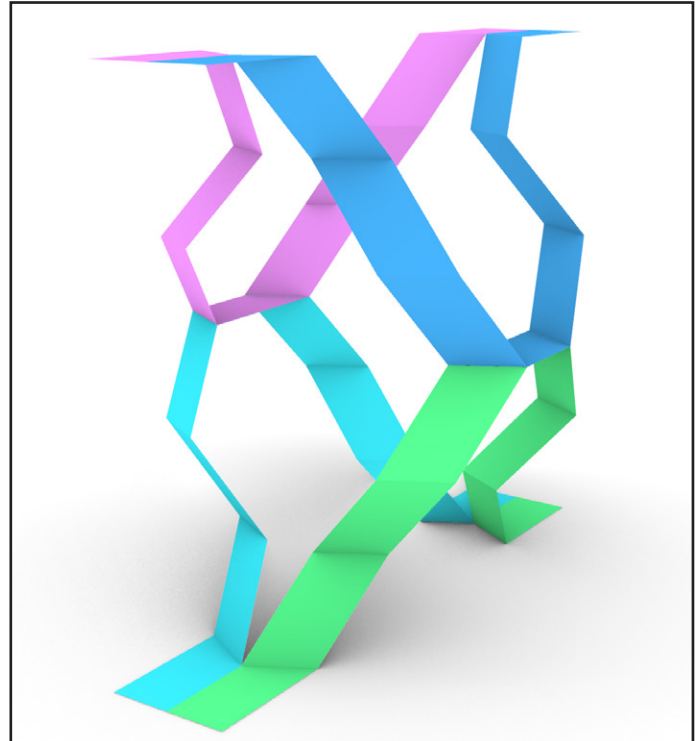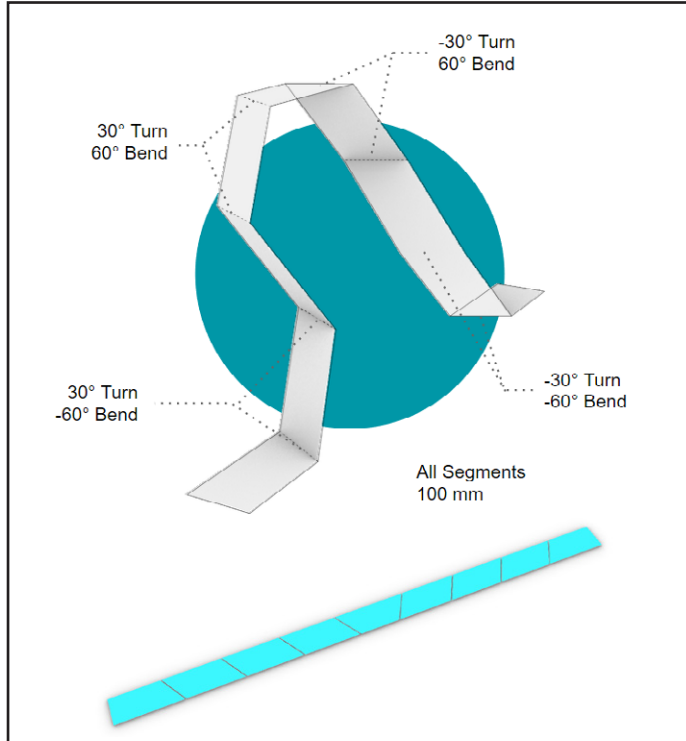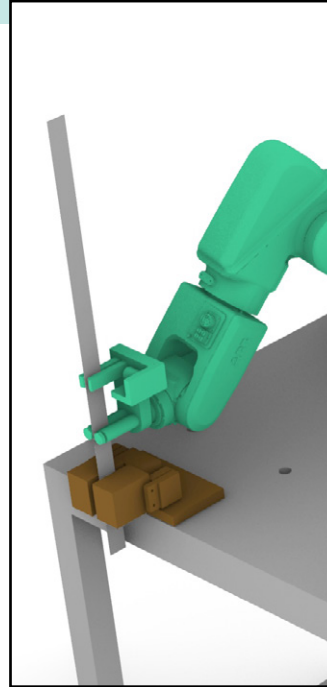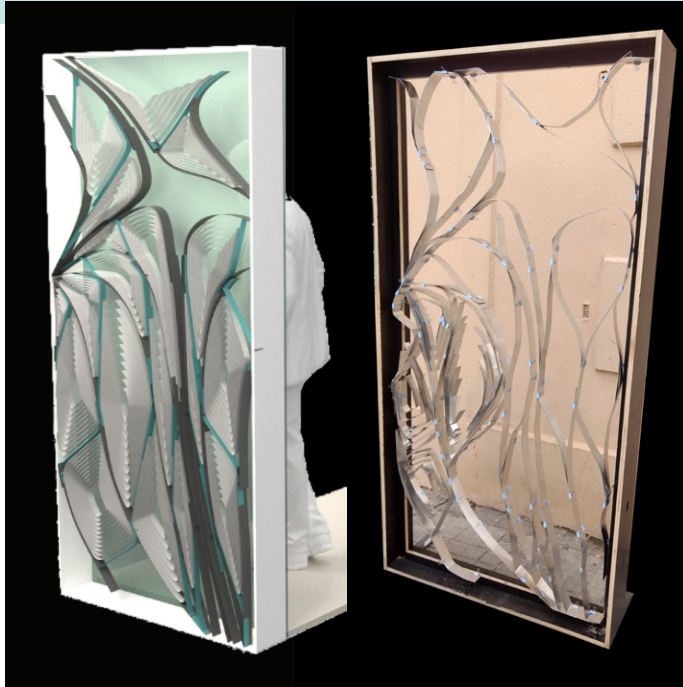
Research into the design and robotic fabrication of modular facade systems - creating three dimensional forms from flat aluminum sheets.
The system is geometrically based entirely on rectilinear strips, to reduce cutoff waste from raw sheets. Careful control of off-plane bends produce controlled volumes and approximate curves. Module fabrication is implemented using a robotic bending system.

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Adaptable Control System

Architectural Robotics Research Group, University of Virginia

Ribbon cable connected to toolhead, communicating via digital IO, serial UART, or serial i2c with tool hardware

Connection with Robot over Ethernet KRL

Connection with consumer devices such as cameras or screens

Tool selection interface

LAPTOP

CONVERT TO BINARY MESSAGES

KRL FILE

NETWORK CONN.

NC SERVER

INTERPRET BINARY MESSAGE

ROBOT

ETHERNET KRL BUFFER

KRL PROGRAM LOOP

PTP
LIN
TIMING
TOOL COMMANDS
ETC.

PERIODICALLY REQUESTING NEW COMMANDS

To assist integration for student projects, I designed a generic and student friendly system for prototyping new tool head workflows in robotic systems. The system uses a Raspberry Pi computer as an intermediary, receiving commands from the Robot via Ethernet KRL while processing camera, serial, or USB input, then sending commands via digital-io, UART serial, or i2c serial to existing consumer devices or micro-controllers in new tools.

Additionally, the system includes custom software for running KRL files over a network for quicker iteration, and semi-reactive toolpaths.

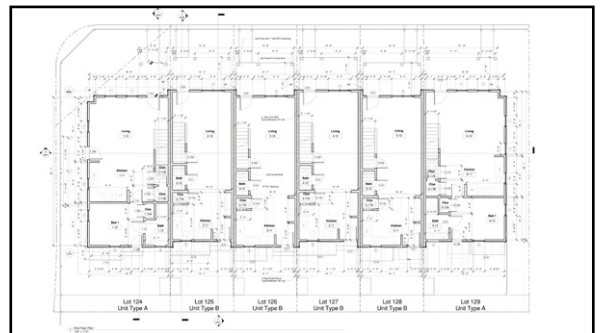# Architectural Work : Concepts + CD

Concepts, Graphics, Design and Construction Documents for Powe Studio Architects
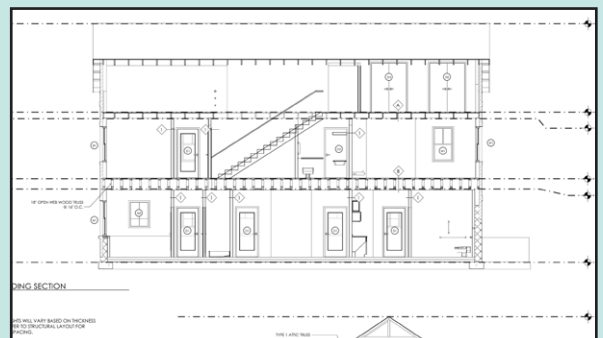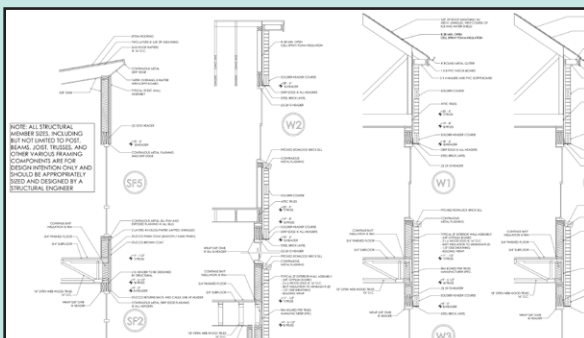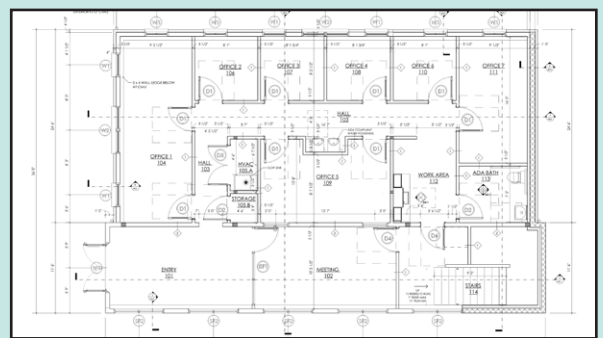

Affordable Residential + Retail, Washington DC

Wickham Pond Townhomes, Habitat for Humanity of Greater Charlottesville

Construction Documents for Design Develop LLC
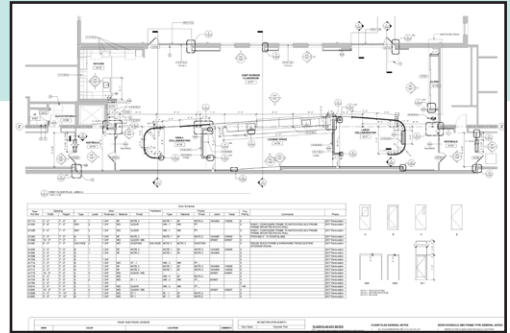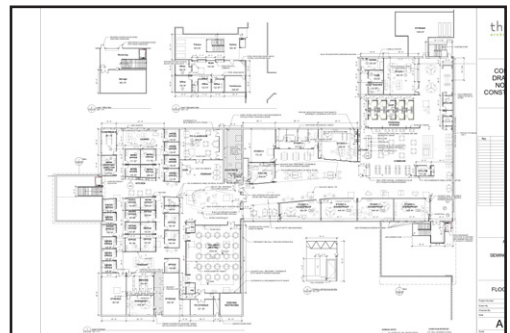

Office Building, Albemarle VA

Design, Graphics and Construction Documents for Thrive Architecture

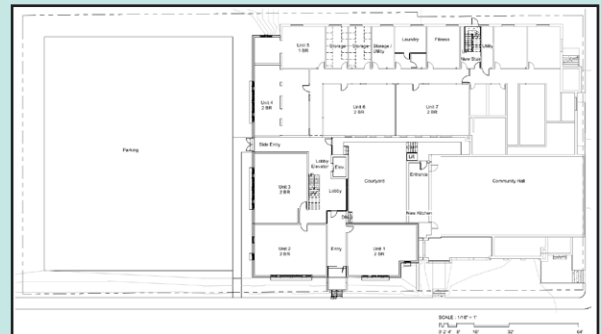**Burley Middle School Modernization, Charlottesville VA**

Albemarle County Public Schools Satellite Tech Center

Concepts and Graphics for Andrew Thomas Architect PLLC

Church Renovation and Addition, Charlottesville VA

Construction for Habitat for Humanity
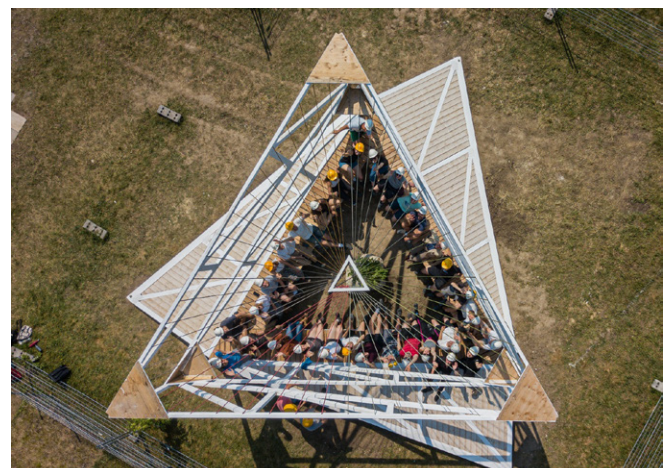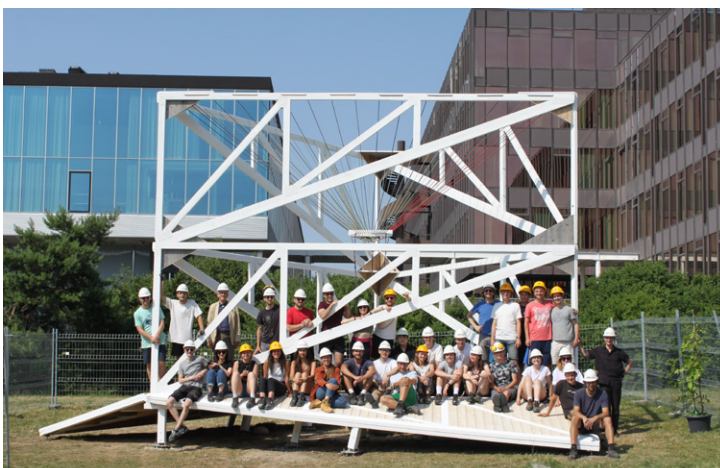

Belmont Cottages

Sunrise Community

Construction from Teaching

Chair of Circular Engineering for Architecture, ETH Zurich
Courses taught for Spring 2022 & 2023

Deconstruction and new construction from *Digital Transformation for Circular Construction*, for which I taught scanning and digitization, design optimization, and construction.

Constructive Solid Geometry Renderer
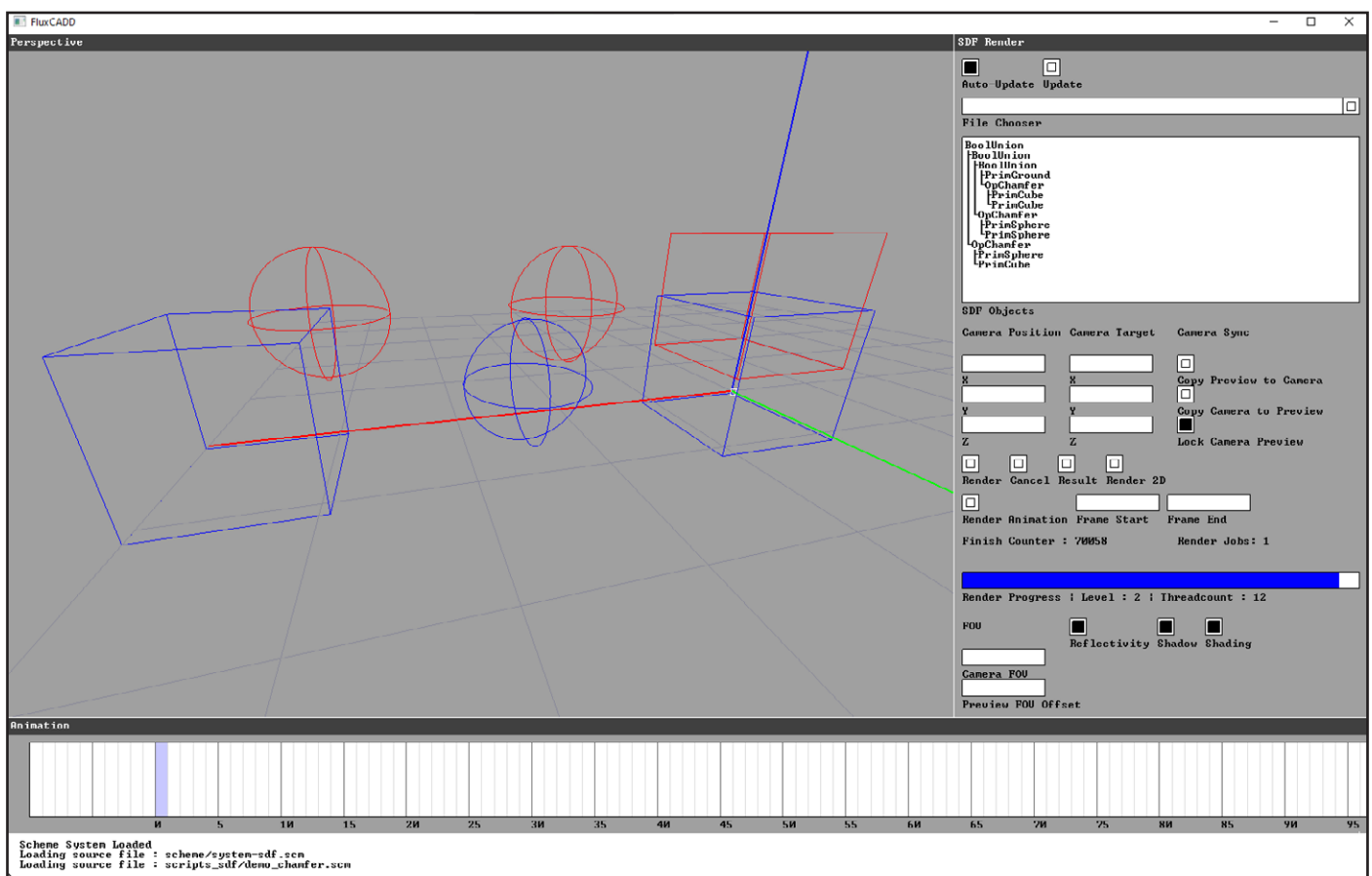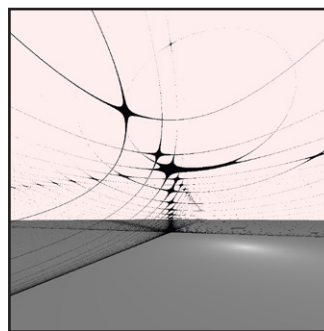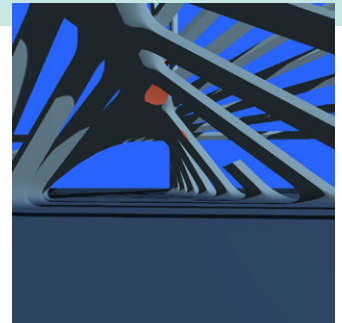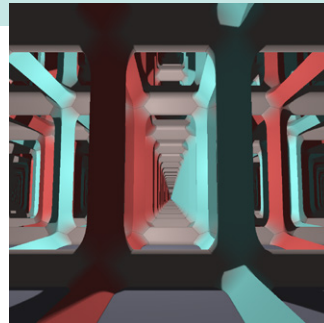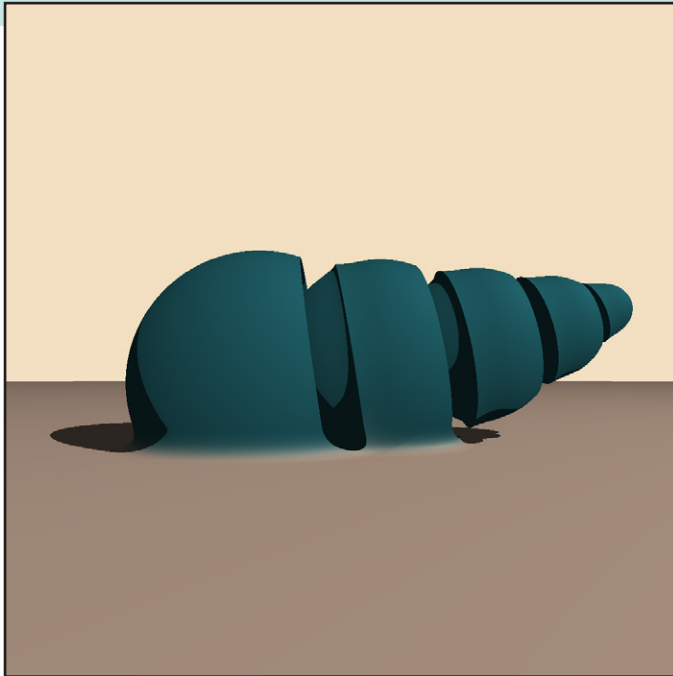
A from-scratch signed-distance-field rendering tool for constructive solid geometry. The system is primarily written in Java, using Scheme as a scene description language covering geometry, materials, and animation.

Upcycled Instruments

Electric and acoustic instruments produced from studio desks, oak flooring, laptop shells, CNC waste, cookware

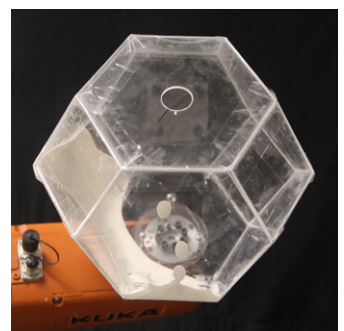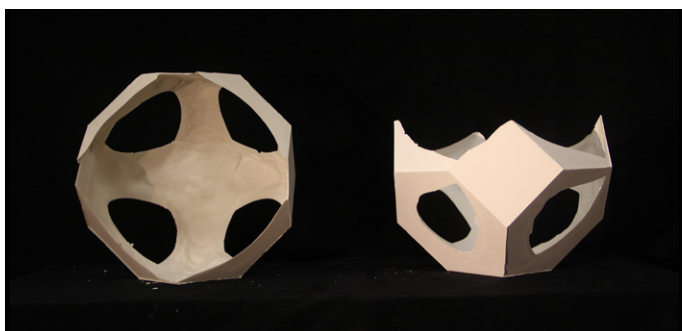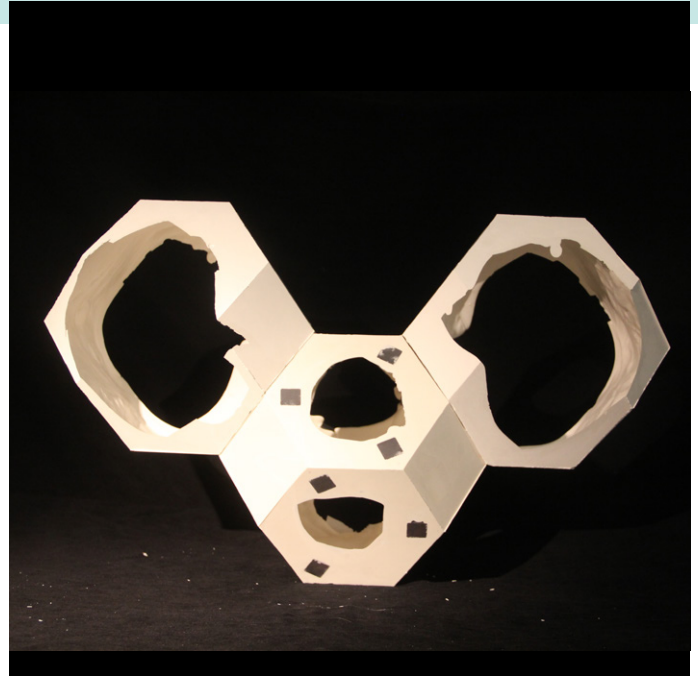Clockwise from top: Banjo, Kalimba, Daxophone, Dulcimer, Bass

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Shell Polyhedra

Architectural Robotics Research Group, University of Virginia
In Collaboration with Matt Johnson

'Shell Polyhedra' explores variations of structure and form in thin-shell rotational casts, via controlled motion during the curing process. The formwork is held by a six-axis robot and oriented along designed paths to fill specific edges and faces of tessellating polyhedra. The resulting objects combine the precision of the geometry and motion with the stochastic forms of flowing liquids. The forms are further assembled using cast-in-place magnets and other hardware.
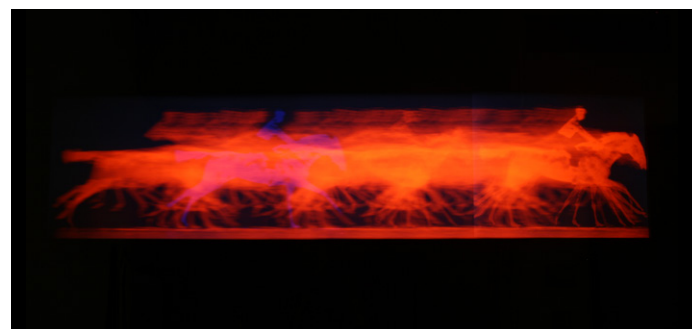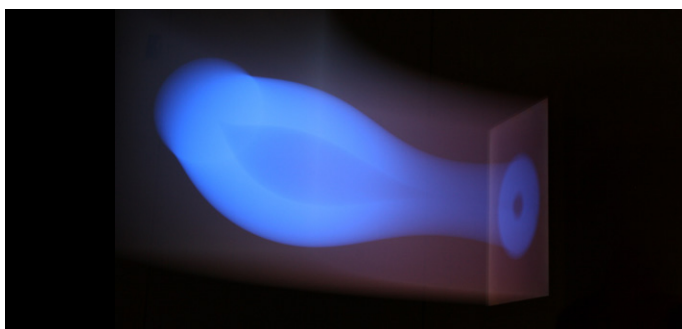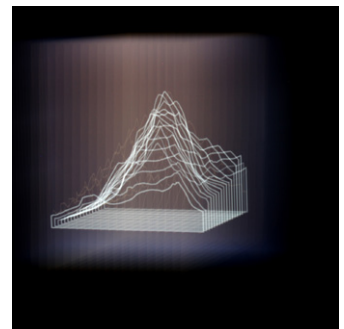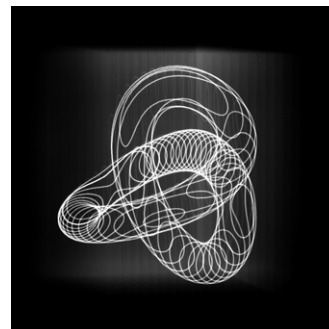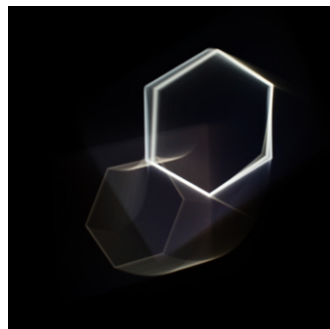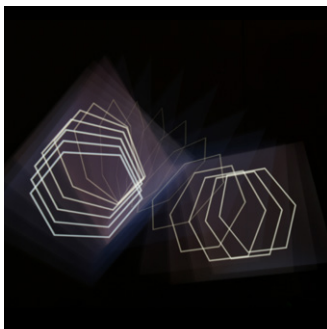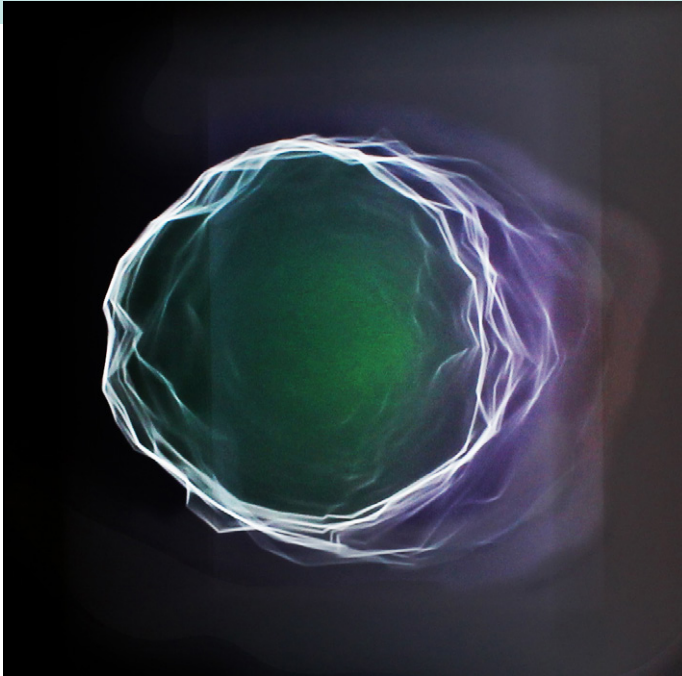
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Circularity | Fabrication | Design | Art

Solid Light

University of Virginia, Architectural Robotics Research Group
In Collaboration with Ben Lawson

Solid Light is an investigation into the intersection of long exposure photography, experimental graphics, and robotic precision. A Kuka Agilus robot is used to position a computer monitor displaying graphics created by live Processing sketches, running on a Raspberry Pi. Variations include the extrusion of simple geometric shapes, the expansion of still images and animations, and recreations of physical forms from vector slices.

Festival of the Moving Creature

University of Virginia
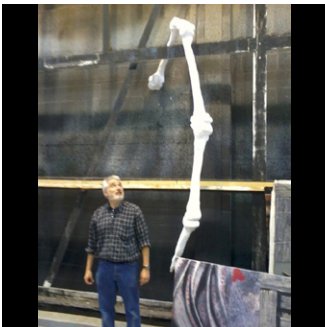
The Festival of the Moving Creature was a year long collaboration between the fabrication arms of the Architecture, Art, and Drama schools of the University of Virginia, alongside the Stan Winston School of Character Arts. The culmination of the project was a series of five full scale puppeteered and animatronic creatures, drawing from the worlds of Hollywood practical effects, parade and festival puppetry, and the artwork of Theo Jansen and Les Machines de L'ile.

I worked on design and fabrication of the creatures pictured, and performed as one of the lead puppeteers in the final parade.